

WHAT IS CLAIMED IS:

1                   1.    A method of forming a rough topology on a  
2    substrate using a planarized process comprising the steps of:  
3                   forming a contact opening having a lateral dimension  
4    exceeding a minimum contact size;  
5                   filling the contact opening with a first plug layer;  
6                   etching back the first plug layer to create a first  
7    cored region in the first plug layer, whereby the first cored  
8    region has a first depression; and  
9                   stacking a first subsequent process layer on the  
10   first cored region, whereby the first subsequent process layer  
11   has a second depression formed on top of the first depression.

1                   2.    The method of claim 1 further comprising the  
2    steps of:  
3                   forming a first via opening on the contact opening;  
4                   filling the first via opening with a second plug  
5    layer;  
6                   etching back the second plug layer to create a  
7    second cored region in the second plug layer, wherein the  
8    second cored region has a third depression formed on top of  
9    the second depression; and  
10                  stacking a second subsequent process layer on the  
11   second cored region, wherein the second subsequent process  
12   layer has a fourth depression formed on top of the third  
13   depression.

1                   3.    The method of claim 2 further comprising the  
2    steps of:  
3                   forming a second via opening on the first via  
4    opening and the contact opening;  
5                   filling the second via opening with a third plug  
6    layer; and  
7                   etching back the third plug layer to create a third  
8    cored region in the third plug layer, wherein the third cored  
9    region has a fifth depression formed on top of the fourth  
10   depression.

1           4.    The method of claim 1 wherein the contact  
2 opening is formed on a polysilicon layer.

1           5.    The method of claim 1 wherein the first  
2 depression has a different optical reflectivity compared to a  
3 relatively planar region of the substrate.

1           6.    The method of claim 1 wherein the second  
2 depression forms a rough, nonplanar topology to scatter  
3 incident radiation, resulting in a dissimilar optical  
4 reflectiveness from a smooth topology of the substrate.

1           7.    The method of claim 1 further comprising the  
2 steps of:

3               forming an insulating layer on the substrate and  
4 covering the first cored region; and

5               removing portions of the insulating layer covering  
6 the first cored region, thereby enhancing an optical contrast  
7 between the second depression and a planar region of the  
8 substrate.

1           8.    The method of claim 1 wherein the first  
2 subsequent process layer is a first metal layer.

1           9.    The method of claim 2 wherein the second  
2 subsequent process layer is a second metal layer.

1           10.   The method of claim 1 further wherein the  
2 lateral dimension is at least about 1.5 times larger than the  
3 minimum contact size.

1           11.   The method of claim 1 wherein a shape of the  
2 contact opening is rectangular.

1           12. An alignment structure formed in a planarized  
2 semiconductor process comprising:

3           a substrate;  
4           a contact opening formed on the substrate;  
5           a first plug layer filling the contact opening, the  
6 first plug layer having a first depressed region in the  
7 contact opening, whereby a topological roughness formed by the  
8 first depressed region scatters incident radiation.

1           13. The alignment structure of claim 12 wherein the  
2 topological roughness contrasts reflectively to a  
3 topologically smooth region.

1           14. The alignment structure of claim 12 wherein the  
2 first depressed region is in about a middle of the contact  
3 opening.

1           15. The alignment structure of claim 12 further  
2 comprising:

3           a first via opening stacked on top of the contact  
4 opening, whereby the first via opening enhances the  
5 topological roughness formed by the first depressed region.

1           16. The alignment structure of claim 15 further  
2 comprising:

3           a second via opening stacked on top of the first via  
4 opening and second via opening, whereby the second via opening  
5 further enhances the topological roughness.

1           17. The alignment structure of claim 12 wherein the  
2 contact opening is larger than a minimum size specified by a  
3 design rule.

1           18. An alignment structure for semiconductor  
2 fabrication comprising:

3           a smooth region formed on a substrate;

4           a rough region formed on the substrate comprising:

5               a first conductive layer;

6               a second conductive layer formed above the  
7 first conductive layer,

8               an first insulating layer, between the  
9 first and second conductive layers, wherein the  
10 first insulating layer has a first opening for  
11 electrically coupling the first and second  
12 conductive layers;

13               a plug layer filling the first opening,  
14 wherein the first plug layer has a cored  
15 region, whereby a topological roughness formed  
16 by the cored region scatters incident  
17 radiation.

1           19. The alignment structure of claim 18 wherein the  
2 rough region further comprises:

3           a third conductive layer formed above the second  
4 conductive layer;

5           a second insulating layer, between the second and  
6 third conductive layers, wherein the second conductive layer  
7 has a second opening, stacked above the first opening, for  
8 electrically coupling the third and second conductive layers,  
9 whereby the second opening aggravates the topological  
10 roughness formed by the cored region.

1           20. The alignment structure of claim 18 wherein the  
2 cored region creates a void above the cored region and second  
3 conductive layer.

1           21. The alignment structure of claim 19 wherein the  
2 opening has a lateral dimension at least about 1.5 times  
3 larger than a minimum size.

1           22. The alignment structure of claim 19 wherein a  
2 passivation layer, covering the substrate, is removed from the  
3 rough region to enhance a reflectivity contrast between the  
4 rough region and smooth region.

1           23. The alignment structure of claim 19 wherein the  
2 smooth region is adjacent to the rough region.

1           24. The alignment structure of claim 19 wherein the  
2 smooth region is formed using a metal layer.